

WE CLAIM :

1. A method of :

- a) reducing an ion of a metal in an aqueous environment;
- b) synthesizing a compound which contains a metal-carbon bond from an ion of said metal in an aqueous environment;
- c) synthesizing an alkyl metal compound from an ion of said metal in an aqueous environment;
- d) synthesizing a metal carbonyl compound from an ion of said metal in an aqueous environment;
- e) synthesizing a metal hydride compound from an ion of said metal in an aqueous environment;
- f) converting an ion of a metal in an aqueous environment into a volatile compound;  
or
- g) extracting an ion of a metal in an aqueous environment;

wherein said metal is selected from the group consisting of noble metals and transition metals comprising the steps of :

- i) adding a carboxylic acid to the aqueous environment; and
- ii) exposing the metal ion and the carboxylic acid in the aqueous environment to a source of UV light.

2. The method of Claim 1 wherein the metal ion is selected from the group consisting of As, Bi, Cu, Au, Pt, Pd, Hg, Sb, Sn, Te, Co, Fe, Cd, Rh, Ag, Se, Pb and Ni .

3. The method of Claim 2 wherein the carboxylic acid is selected from the group consisting of formic acid, acetic acid, propionic acid and malonic acid.
4. The method of Claim 3 wherein the metal ion is an ion of Se.
5. The method of Claim 3 wherein the metal ion is an ion of Ni.
6. The method of Claim 3 wherein the metal ion is an ion of Hg.
7. The method of Claim 3 wherein the metal ion is an ion of As.
8. The method of Claim 1 comprising the additional step of adding a photocatalyst to the aqueous environment.
9. The method of Claim 8 wherein the photocatalyst is selected from  $\text{TiO}_2$  and  $\text{NO}_3^-$ .
10. A method of :
  - a) reducing an ion of an element in an aqueous environment;
  - b) synthesizing a compound which contains an element-carbon bond from an ion of said element in an aqueous environment;
  - c) synthesizing an alkyl element compound from an ion of said element in an aqueous environment;

- d) synthesizing an element carbonyl compound from an ion of said element in an aqueous environment;
- e) synthesizing an element hydride compound from an ion of said element in an aqueous environment;
- 5 f) converting an ion of an element in an aqueous environment into a volatile compound; or
- g) extracting an ion of an element in an aqueous environment;
- wherein said element is selected from the group consisting of S, P, I, As, Bi, Cu, Au, Pt, Pd, Hg, Sb, Sn, Te, Co, Fe, Cd, Rh, Ag, Se, Pb and Ni comprising the steps of :
- 10 i) adding a carboxylic acid to the aqueous environment; and
- ii) exposing the ion of the element and the carboxylic acid in the aqueous environment to a source of UV light.
11. The method of Claim 10 wherein the carboxylic acid is selected from the group
- 15 consisting of formic acid, acetic acid, propionic acid and malonic acid.
12. The method of Claim 10 comprising the additional step of adding a photocatalyst to the aqueous environment.
- 20 13. The method of Claim 12 wherein the photocatalyst is selected from  $\text{TiO}_2$  and  $\text{NO}_3^-$ .

14. A method of converting an ion of a metal in an aqueous environment into a volatile compound wherein said metal is selected from the group consisting of noble metals and transition metals comprising the steps of :
- 5        i)        adding a carboxylic acid to the aqueous environment; and
- ii)        exposing the metal ion and the carboxylic acid in the aqueous environment to a source of UV light.
15. The method of Claim 14 wherein the metal ion is selected from the group consisting of As, Bi, Cu, Au, Pt, Pd, Hg, Sb, Sn, Te, Co, Fe, Cd, Rh, Ag, Se, Pb and Ni .
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16. The method of Claim 15 wherein the carboxylic acid is selected from the group consisting of formic acid, acetic acid, propionic acid and malonic acid.
17. The method of Claim 16 wherein the metal ion is an ion of Se.
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18. The method of Claim 16 wherein the metal ion is an ion of Ni.
19. The method of Claim 16 wherein the metal ion is an ion of Hg.
- 20    20. The method of Claim 16 wherein the metal ion is an ion of As.

21. The method of Claim 14 comprising the additional step of adding a photocatalyst to the aqueous environment.
22. The method of Claim 21 wherein the photocatalyst is selected from  $\text{TiO}_2$  and  $\text{NO}_3^-$ .